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(54) PANEL INSERTS AND METHODS OF INSTALLATION

(71) We, ILLINOIS TOOL WORKS INC., a corporation organized under the laws of the State of Delaware, United States of America, of 8501 West Higgins Road, Chicago, Illinois 60631, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

In instances where the weight of a panel structure is significant, as for example, in panels used on the interior of aircraft and the like, it has been common practice to employ panels of the honeycomb type. Such panels include a honeycomb core, sandwiched between two skins secured to the opposite sides of the core. Panels of this type, while light in weight, exhibit considerable lateral strength. Obviously, conventional type fasteners, such as screws, cannot satisfactorily be accommodated by honeycomb type panels without the use of an auxiliary screw-accommodating insert embedded within the panel. The present invention is concerned primarily with improved screw-accommodating panel insert assemblies which are particularly suitable for use with the above-mentioned lightweight, honeycomb panel structures.

An insert assembly according to the present invention comprises: an insert member having a base with opposite first and second substantially flat surfaces and a neck extending from the second surface and having an open-ended threaded bore, this neck having a peripheral surface perpendicular to the second surface and having a width less than the second surface; an annular member, surrounding the periphery of the neck and formed of a materal which on heating will become viscous and able to flow, and after subsequent cooling will be solid; and an annular collar superimposed on the member, this collar comprising an apertured end wall, an inner wall lying between the member and the neck and extending axially from the inner edge of the end wall towards the base a distance less than the axial extent of the annular member, and an outer wall overlying a portion of the exterior of the member and extending from the end wall towards the base a distance less than the axial extent of the inner wall.

The accompanying drawings show one example of an insert assembly according to this invention, and its method of installation. In these drawings:—

Figure 1 is a plan view of the insert assembly in its initial position of insertion within a honeycomb panel;

Figure 2 is a perspective view of the assembly shown in Figure 1;

Figure 3 is a fragmentary enlarged section taken substantially along the line 3-3 of Figure 1, this view showing the position of the insert assembly prior to the application of heat to the collar;

Figure 4 is a section similar to Figure 3, showing the final position of the insert assembly after heat has been applied;

Figure 5 is a view, similar to Figure 4, showing the manner in which a screw may be received by the internally threaded insert member for securing a component to the panel;

Figure 6 is a perspective view showing the internally threaded insert member axially separated from the annular collar and annular member; and,

Figure 7 is a perspective view, similar to Figure 2, showing the neat, flush appearance of the exposed extremity of the insert assembly after it has been finally secured to the honeycomb panel.

The insert assembly 10 includes an insert member 12 having a base 14, and an internally threaded neck 16 extending

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axially from and formed integral with one side of the base 14. The insert assembly 10 also includes an annular member 18 surrounding the neck 16, formed of a thermoplastic adhesive. Thus the material of the annular member 18 is solid in its unheated stage, and when subjected to heat will become viscous and able to flow.

An annular collar 20 engages the inner and outer peripheries of the upper portion of the annular member 18, as well as an end surface thereof. For reasons hereinafter set forth, the inner wall of the collar 20 is of greater axial extent than the outer wall as clearly shown in figures 3 and 4, the inner wall thus extending beyond the outer wall towards the base 14. The inner peripheral surface of the inner wall of the collar 20, at the time of initial telescopic assembly thereof with the insert member 12, closely surrounds the outer periphery of the insert neck 16. In this manner the insert member 12, the annular member 18 and the collar 20 constitute an insert assembly. The collar 20 is preferably formed from sheet metal which will readily conduct heat applied thereto. The insert member 12 may consist of a suitable plastics material which is a poor conductor of heat, such as that known by the Registered Trade Mark Delrin.

The panel 22 comprises a core 24 of honeycomb material secured between a skin 26 adhered to one side and a similar skin 28 adhered to the other side. The skins 26 and 28 may be of plastics material reinforced with glass fibres. Before installation of the insert assembly 10, the skin 28 and the honeycomb core 24 are routed as shown in Figure 3. The resultant opening in the honeycomb core 24 is designated by the numeral 30. Upon insertion of the assembly 10 within the opening 30, the end surface of the base 14 of the insert member 12 rests against the inner surface of the skin 26. Pull-out strength may be added to the assembly by coating the base of the insert member 12 with an adhesive to cause it to adhere to the inner surface of the skin 26. The axial length of the insert member is designed to suit the thickness of the panel, so that the upper end of the neck 16 lies, after insertion, in the plane of the outer surface of the skin 28.

The upper extremity of the annular member 18, and the upper portion of the collar 20 associated therewith, project outside the skin 28. That is to say, the annular member 18 is of greater axial length than the neck. The application of heat will cause the thermoplastic annular member 18 to melt so as to be able to flow into the opening 30 in the honeycomb core 24.

Preferably the heat is applied to the collar 20, e.g. by induction, and transferred from it to the annular member 18.

The collar may, alternatively, be formed of a non-conductive material. In cooperation with a non-conductive collar, the annular member 18 may be formed of metal-filled or metal-oxide-filled thermosetting adhesives. In this case the annular member is directly heated, by induction.

As a further alternative, ultrasonic energy may be applied to a sheet metal collar to provide heat for the annular member 18.

The thermoplastic adhesive material of the annular member 18, upon being heated, becomes viscous, and downward force applied to the collar 20 (by means not shown) will shift the collar axially inwardly along the neck 16, and cause the annular member to spread, until the thermoplastic material substantially fills the opening 30. The collar 20 will ultimately assume the position shown in Figure 4, with the outer end surface thereof flush with the outer surfaces of the skin 28 and the neck 16. The engagement of the leading end of the inner wall of the collar 20 with the base portion 14, as shown in Figure 4, ensures the proper positioning of the outer end surface of the collar 20. The flush neat appearance of the completely installed insert assembly is shown clearly in Figure 7. The outer wall of the collar is of less axial extent that the inner wall, so as not to obstruct flow of material from the annular member 18 into the opening 30.

Upon cooling, the annular member 18 will solidify and will become bonded to the walls of the honeycomb core 24 around the opening 30, and to the inner surfaces of the skins 26 and 28. A nitrile-phenolic mix is representative of the type of thermoplastic adhesive which may be employed in making the annular member 18.

With the above described insert assembly 10 securely bonded within the honeycomb core 24, a screw 32 may be applied to the internally threaded neck 16 and clamped against a component 34. The component 34 is merely representative of many objects which may be secured firmly to the panel after the assembly 10 has been installed in the above described manner.

While the base of the insert member 12 is shown as being substantially annular, it could be configured with serrations or apertures to further resist rotation thereof.

From the foregoing it will be apparent that the present invention provides a very simple procedure for permanently securing an internally threaded insert within a honeycomb type panel. The combined internally threaded insert member, the annular member of thermoplastic material,

and the annular collar, provide an insert assembly which may be handled as a single unit. Thus the ease and convenience with which a screw-accommodating insert may be secured firmly within a honeycomb panel is great.

While many of the commercially available honeycomb panel structures are formed of heat-resistant resinous materials, others are composed of lightweight sheet metal such as aluminium. It should be understood that the present invention may be used with equal facility in each type of honeycomb panel structure. By employing a suitable thermoplastic adhesive for the annular member 18, it is possible to obtain a very firm, strong and permanent bond between the internally threaded insert member and the honeycomb core.

WHAT WE CLAIM IS:—

1. An insert assembly comprising: an insert member having a base with opposite first and second substantially flat surfaces and a neck extending from the second surface and having an open-ended threaded bore, this neck having a peripheral surface perpendicular to the second surface and having a width less than the second surface; an annular member surrounding the periphery of the neck and formed of a material which on heating will become viscous and able to flow, and after subsequent cooling will be solid; and an annular collar superimposed on the member, this collar comprising an apertured end wall, an inner wall lying between the member and the neck and extending axially from the inner edge of the end wall towards the base a distance less than the axial extent of the annular member, and an outer wall overlying a portion of the exterior of the member and extending from the end wall towards the base a distance less than the axial extent of the inner wall.

2. An insert assembly according to claim 1, wherein the annular member is of greater axial length than the neck.

3. An insert assembly according to claim 1 or claim 2, wherein the annular member is formed of a thermoplastic adhesive.

4. An insert assembly according to claim 3, wherein the annular member is formed of nitrile-phenolic mix.

5. An insert assembly according to any of claims 1 to 4, wherein the collar is of heat-conductive material.

6. An insert assembly according to claim 5, wherein the collar is of sheet metal.

7. An insert assembly according to claim 1, substantially as described with reference to the accompanying drawings.

8. A method of installing an assembly according to any of claims 1 to 7 within a panel of the type comprising a honeycomb core sandwiched between two skins, the method including the steps of making an opening in the panel, the opening extending through a first one of the panel skins and continuing through the core but not through the second skin, placing the assembly within the opening with the first surface of the insert member positioned adjacent to the second skin and the collar projecting axially outside the first skin, subjecting the annular member to heat so as to cause the material of the member to become viscous, and axially shifting the collar towards the second skin so as to cause the material to flow into the opening in the core, and then permitting the material of the member to solidify.

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2 SHEETS This drawing is a reproduction of the Original on a reduced scale
Sheet 1

Fig. 1

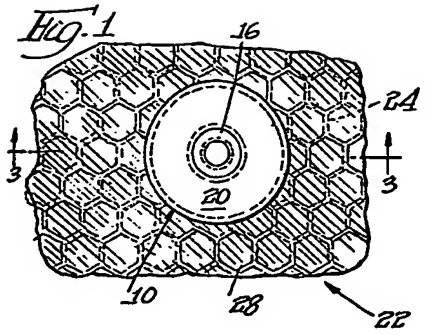

Fig. 2.

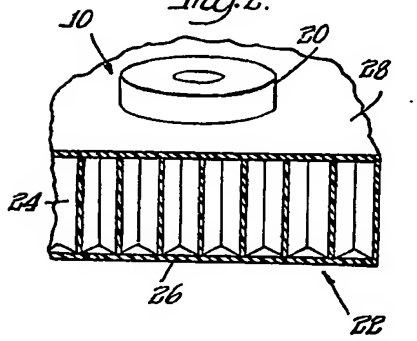

Fig. 3.

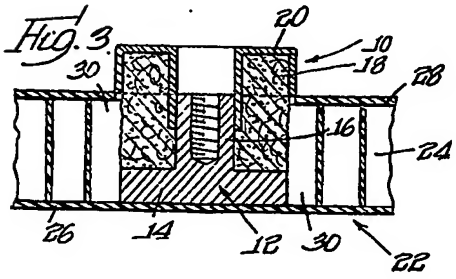

Fig. 4.

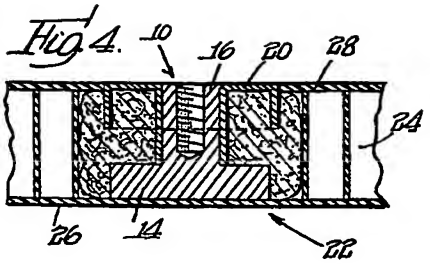

Fig. 5.

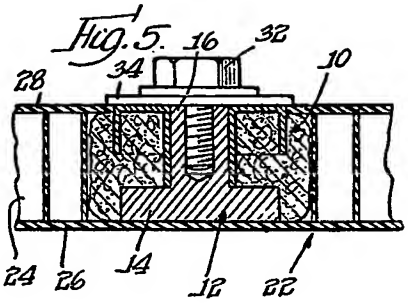

Fig. 6.

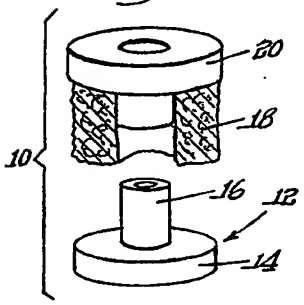

Fig. 7.